REMARKS

The application has been reviewed in light of the final Office Action dated June 25, 2008. Claims 18-21 and 24-41 are pending in this application, with claims 1-17, 22 and 23 having previously been canceled, without prejudice or disclaimer. By the present Amendment, claims 18 and 30 have been amended by moving into claim 18 a feature that was formerly recited in claim 30. Since no new matter and no new issues have been introduced by the present Amendment, entry of the Amendment is requested. Upon entry of this Amendment, claims 18-21 and 24-41 remain pending in this application, with claim 18 being the sole pending claim in independent form.

Claims 18-21 and 24-41 were rejected under 35 U.S.C. § 103(a) as purportedly unpatentable over U.S. Patent No. 6,198,960 to Fain et al. in view of in view of U.S. Patent No. 5,307,014 to Laub.

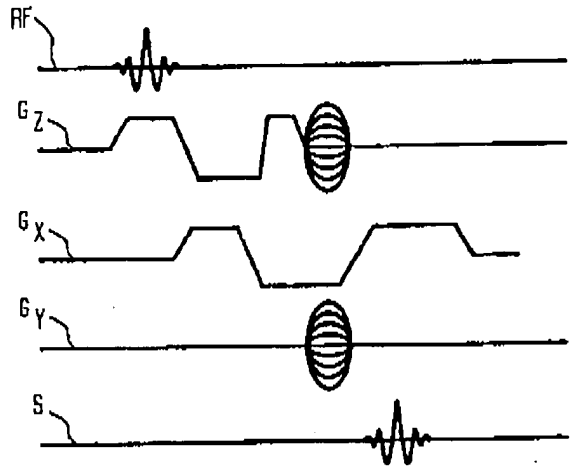
Fain, as understood by Applicant, proposes an approach for performing magnetic resonance angiography study of a subject, wherein a flip angle of a RF excitation pulse used in an imaging pulse sequence is modulated, during execution of the imaging pulse sequence, such that the flip angle changes as a function of contrast agent concentration in the region of interest.

However, Fain, as acknowledged in the Office Action, does not disclose or suggest changing repetition time (TR) in accordance with concentration of a contrast agent.

Laub, as understood by Applicant, proposes an approach for performing 3-D MR angiography the RF excitation applied to an imaging volume is modified so as to cause a spatially dependent variation in RF excitation within the imaging volume. For example, the RF excitation is applied so as to cause the spins to experience an increasing flip angle as they

proceed through the imaging volume. The excitation applied in Laub is a single RF pulse, as shown in Fig. 4 (reproduced below) of Laub.

FIG. 4



It is contended in the Office Action that Laub, col. 2, lines 16-60 and col. 6, lines 31-42 (reproduced below), proposes adjusting repetition time TR in order to optimize the signal intensity.

> One emerging MR imaging modality is flow or vascular imaging. One basic physical principle which is used to acquire flow images in the MR environment uses time-of-flight effects. Time-of-flight effects are based on the macroscopic motion of nuclear spins with longitudinal magnetization. Typically, the magnetization of a bolus of blood is labelled at one time (via a selective RF excitation) and detected at a later time (at readout). Because the bolus changes location between labelling and detection, the name time-of-flight is used. Inflow enhancement is a special case of time-of-flight, in which the bolus is excited and detected in the same slice. An example of inflow enhancement effects in MR imaging is shown in FIG. 1a, wherein the flow is perpendicular to the slice plane. ***During a single repetition time, some of the spins flow out of the slice and are replaced by others flowing into the slice. Repeated MR imaging sequences result in the stationary tissue becoming partially or fully saturated after a few repetition times, thereby diminishing any signal from the stationary tissue.*** The blood flowing into the selected slice provides unsaturated spins which produce high signal and high contrast relative to that of the adjacent stationary tissue. Thus, ***if the excitation pulse repetition time (TR) is short relative to***

> ***the time required for the longitudinal magnetization to become substantially relaxed (T1), over the course of several TR intervals signal from stationary tissue will be attenuated as their spins become more and more saturated.*** Unfortunately, the flowing blood will also become partially saturated, which saturation manifests itself as a reduction in signal. However, some partially saturated spins in the blood will flow out of the slice and are replaced by unsaturated spins which have higher signal capability. ***As more unsaturated spins flow into the slice during each TR, more signal is available. The flow signal is maximized when all the partially saturated flowing spins in the slice are replaced each TR.*** Thus, signal enhancement is directly related to the flow velocity and slice thickness. Further information relating to time-of-flight effects can be found in the article "Time-of-Flight MR Flow Imaging: Selective Saturation Recovery with Gradient Refocusing", published in Radiology, 1986, No. 160, Pages 781-785.
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> As previously described, when fully relaxed spins move into the imaging volume, their degree of saturation progressively increases, whereby the longitudinal magnetization becomes progressively decreased. This effect is shown in FIG. 6. The ***exact behavior of the magnetization strongly depends on the applied flip angle α, the pulse repetition time TR, and longitudinal relaxation time T1***. As previously noted, the signal that is received in an actual MR experiment directly relates to the amount of transverse magnetization, which depends on the longitudinal magnetization according to the following equation:
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> $$M_{transverse}=M_{longitudinal}\cdot\sin(\alpha)$$

Thus, Laub merely points out that the signal from stationary tissue will be attenuated if $TR < T_1$, and more unsaturated spins flowing into a slice during TR make more signal available, and that the exact behavior of the magnetization depends on many parameters including TR.

However, Laub, like Fain, says nothing whatsoever regarding changing repetition time (TR) depending on a concentration of a contrast agent, such that TR has a shorter value during the higher concentration period than a value during the lower concentration period.

Such aspect of (independent claim 18 of) this application (that is, changing a value of TR depending on a concentration of a contrast agent, such that TR has a shorter value during the higher concentration period than a value during the lower concentration period) allows an image to be taken under optimum conditions following the concentration of the contrast agent which is

injected into an object and changed at every moment with time.

Applicant submits that the cited art, even when considered along with common sense and common knowledge to one skilled in the art, does ***NOT*** render obvious such aspect of the present application, and that independent claim 18 and the claims depending therefrom therefore are allowable over the cited art.

In view of the remarks hereinabove, applicant submits that the application is now in condition for allowance, and earnestly solicits the allowance of the application.

If a petition for an extension of time is required to make this response timely, this paper should be considered to be such petition. The Patent Office is hereby authorized to charge any required fees, and to credit any overpayment, to our Deposit Account No. 03-3125.

If a telephone interview could advance the prosecution of this application, the Examiner is respectfully requested to call the undersigned attorney.

Respectfully submitted,

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